# 4 Sediment, Water, and Tissue Chemistry Data

This section describes the data set used for both the human health and ecological risk assessments. As part of the remedial investigation/feasibility study (RI/FS), several state, federal, university, and private-party studies conducted for the Lower Fox River and Green Bay were identified, and requests were made for electronic copies of the study data. These data were assembled into the Fox River Database (FRDB) as shown in Table 4-1. This list of data sets includes data that were used as part of the SLRA as well as additional data sets.

"Electronic Data" collected from the various resources were incorporated into the FRDB. Requests were submitted for sediment, tissue, and water data. Data were provided in various file formats, including document files (i.e., Word, WordPerfect), spreadsheets, ASCII files, database tables, and drawings (i.e., CADD, GIS files). The data were extracted from the files into individual database tables for standardization prior to inclusion into the FRDB.

The reduced and standardized data sets were compiled into a database for use in support of the ongoing risk assessment (RA) and RI/FS. The database currently contains 474,218 records from 35 individual data sets representing sediment, tissue, air, and pore water data. The data in the FRDB were collected primarily between 1989 and 1998 along the Fox River from Lake Winnebago to northern Green Bay. This information has been grouped in multiple ways to facilitate risk assessment calculations, summarizing the data by river stretch or Green Bay zone, species (common name), and sample type. Not all records in the FRDB were used for the risk assessment; data were limited based on species, year, location, tissue, and analyte. Specific data sets used for the risk assessment are presented in Table 4-2.

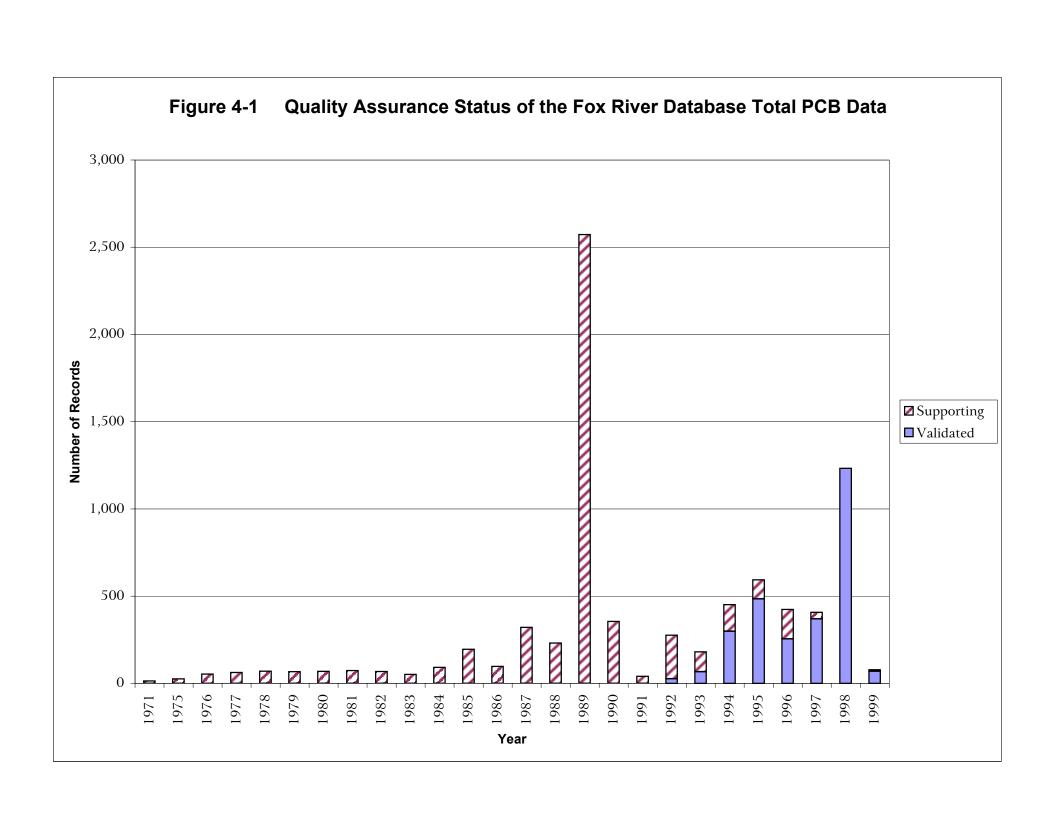
Total PCBs are the most frequently found analyte in the database. Table 4-3 presents the number of total PCB samples by year and media type, along with the quality assurance (QA) status of the data, which is also presented on Figure 4-1. Tables 4-4 and 4-5 contain a breakdown of the total PCB tissue data over time and by type of ecological receptor. 1989 was used as a cut-off date for inclusion of data for the evaluation of risk for several reasons: 1) the contribution of these data towards assessing risk was considered to be less advantageous than the greater accuracy obtained by evaluating risk based on more current data, 2) no data collected prior to 1989 were validated, and 3) although data collected in 1989 were not validated, the total number of samples collected in this year is

more than 30 percent of all samples collected. Data validation is a process that is conducted to determine the quality of the data. A QA status of "supporting" is given to data when the precise quality of the data is not known. However, it was assumed that these data were of sufficient quality for inclusion in the risk assessment. A complete description of the FRDB, quality assurance, and quality control issues is given in the 2000 Fox River Data Management Summary Report (EcoChem, 2000).

## 4.1 Section 4 Figure and Tables

Section 4 figure and tables follow this page and include:

- Figure 4-1 Quality Assurance Status of the Fox River Database Total PCB Data
- Table 4-1 Description of All Records Contained in the Fox River Database
  Table 4-2 Number of Records Evaluated as Part of the Baseline Risk
  Assessment All COPCs
- Table 4-3 Distribution of Existing Sediment, Water, and Tissue Data in the Lower Fox River and Green Bay over Time Total PCBs Only
- Table 4-4 Distribution of Resident Tissue Samples over Time in the Lower Fox River Total PCBs Only
- Table 4-5 Distribution of Resident Tissue Samples over Time in Green Bay Total PCBs Only



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Table 4-1 Description of All Records Contained in the Fox River Database

Data Source	Number of Samples	Matrices <sup>1</sup>	Analyses Conducted <sup>2</sup>	Number of Records	Number of Files in Delivery	File Type
1989/90 Fox River Mass Balance Study	1,967	S, W	PCB-A, PCB-C, W	25,457	6	Spreadsheet
1989/90 Green Bay Mass Balance Study (GLNPO)	2,069	S, T, W	B, PCB-C, W	201,701	91	Database
1992/93 BBL Deposit A Data Collection	117	S, W	M, P/H, PCB-A, SVOA, V, W	1,094	1	Spreadsheet
1993 Triad Assessment	27	S	B, M, P/H, PCB-A, SVOA, W	631	11	Spreadsheet
1993-1996 Tree Swallow Data Collection	200	T	B, DXN, P/H, V, W	5,429	2	Database
1994 GAS Sediment Collection	253	S	DXN, M, P/H, PCB-A, SVOA, V, W	5,654	6	Spreadsheet
1994 Woodward-Clyde Deposit A Sediment Collection	66	S	PCB-A, W	585	12	Spreadsheet
1994-1995 Cormorant Data Collection	193	T	B, DXN, P/H, PCB-C, W	6,178	2	Database
1995 WDNR Sediment Data Collection	488	S	M, PCB-A, W	6,433	8	Spreadsheet
1996 BBL Sediment/Tissue Data Collection	25	S, T	B, PCB-C, W	2,771	6	Spreadsheet
1996 WDNR Tissue Data Collection	200	T	B, PCB-A, W	1,673	1	Spreadsheet
1997 Demonstration Project Data - Deposit N	10	S	M, PCB, W	83	1	Spreadsheet
1997 Demonstration Project Data - Segment 56/57	295	S, W	DXN, M, P/H, PCB-A, SVOA, V, W	3,114	12	Spreadsheet
1997 USFWS Waterfowl Tissue Data Collection	70	T	B, P/H, PCB, V, W	1,680	2	Database
1997 WDNR Caged Fish Bioaccumulation Study Data	25	S, T	B, PCB-C, W	1,672	2	Spreadsheet
1998 BBL Sediment/Tissue Data Collection	1,315	S, T, W	B, M, P/H, PCB-A, PCB-C, RAD, SVOA, W	18,824	1	Database
1998 Deposit N Post-Dredge	43	S	PCB-A, PCB-C, W	690	8	Spreadsheet
1998 Deposit N Pre-Dredge	53	S	PCB-A, PCB-C, W	1,437	6	Spreadsheet
1998 FRG/Exponent Database Data Collection	225	T	B, M, P/H, PCB-A, PCB-C, W	17,708	3	Database
1998 RETEC RI/FS Supplemental Data Collection	252	S, T	B, DXN, M, P/H, PCB-A, PCB-C, SVOA, V, W	10,781	1	ASCII
1998 WDNR Fish Consumption Data	130	T	B, M, PCB-A, W	777	1	ASCII
1998/1999 Deposit N Sediment Remediation Data	197	T, W	PCB-C, W	10,264	1	Spreadsheet
Ankley and Call	62	PW, S, T, W	DXN, M, P/H, PCB, SVOA, W	1,607	0	Hardcopy
Deposit N Operational Monitoring Data	12	S	M, PCB-A, W	123	1	Spreadsheet
Fox River Fish Consumption Advisory Data	1,766	S, T	B, DXN, M, P/H, PCB-A, PCB-C, SVOA, V, W	11,620	2	ASCII
Lake Michigan Fish Consumption Advisory Data	434	T	B, DXN, M, P/H, PCB-A, W	6,979	1	Database
Lake Michigan Mass Balance Study	6,987	A, S, T, W	M, P/H, PCB-C, V, W	91,621	211	Database
Lake Michigan Tributary Monitoring Data	88	W	M, P/H, PCB-C, V	5,722	5	Spreadsheet
Lower Fox River Background Metals Assessment	14	W	M	78	1	Spreadsheet
Minergy Mineralogical Data	15	S	W	219	1	Spreadsheet
Stromberg Eagle Data Collection	31	T	B, DXN, P/H, PCB-A, PCB-C, SVOA, V, W	954	l	ASCII
1996 USFWS NRDA Tissue Data Collection	376	T	DXN, P/H, PCB-A, PCB-C, W	15,401	4	Spreadsheet
USGS NAWQA Data	441	S, T, W	B, M, P/H, PCB, SVOA, V, W	11,879	21	Spreadsheet
WDNR Tissue Data Collection	417	T	B, M, P/H, PCB-A	2,532	3	Database
WPDES Permit Influent Data	8	W	B, DXN, M, P/H, PCB-A, RAD, SVOA, V, W	847	1	Spreadsheet
Total: 35 Data Sets	18,871			474,218	436	

### <sup>1</sup>Matrices

S - Sediment T - Tissue

W - Water

PW - Sediment Pore Water

A - Ambient Air

### <sup>2</sup>Analyses

PCB-A - PCB Aroclor PCB-C - PCB Congener PCB - Total PCB only

M - Metals

W - Wet Chemistry (including all physical and conventional data)

V - Volatiles

SVOA - Semivolatiles

P/H - Pesticides/Herbicides

DXN - Dioxins

B - Biological

Table 4-2 Number of Records Evaluated as Part of the Baseline Risk Assessment - All COPCs

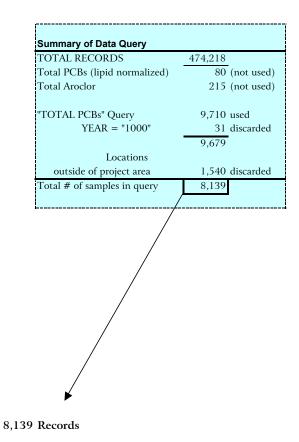
Source	Data Set	Total	Water	Sediment
Sediment and Water Data				
1989/90 Mass Balance Sediment Data	1989/90 Fox River Mass Balance Study	1,207		1,207
1989/90 Mass Balance Water Column Data	1989/90 Fox River Mass Balance Study	502	502	
1993 Triad Assessment	1993 Triad Assessment	59		59
1994 Sediment Data - SAIC and GAS	1994 GAS Sediment Collection	571		571
1995 Sediment data collection - WDNR	1995 WDNR Sediment Data Collection	684		684
1996 BBL Sediment Data collected for FRG	1996 BBL Sediment/Tissue Data Collection	68		68
1997 Deposit N demonstration project	1997 Demonstration Project Data - Deposit N	12		12
1997 Segment 56/57 demonstration project	1997 Demonstration Project Data - Segment 56/57	374	8	366
1998 BBL Sediment/Tissue Data collected for FRG	1998 BBL Sediment/Tissue Data Collection	1,389	329	1,060
1998 Deposit N Operational Monitoring	Deposit N Operational Monitoring Data	20		20
1998 Deposit N Post-Dredge Sediment Data	1998 Deposit N Post-Dredge1	18		18
1998 Deposit N Post-Dredge Sediment Data	1998 Deposit N Post-Dredge2	43		43
1998 Deposit N Pre-Dredge Sediment Data	1998 Deposit N Pre-Dredge	103		103
1998 RI/FS Supplemental Data Collection	1998 RETEC RI/FS Supplemental Data Collection	528		528
1998/1999 Deposit N Sediment Remediation Data	1998/1999 Deposit N Sediment Remediation Data	298	298	
Caged fish associated sediment samples 1997 demo projects	1997 WDNR Caged Fish Bioaccumulation Study Data	35		35
Fish Contaminant Study Data	Fox River Fish Consumption Advisory Data	8		8
Fox River background metals assessment data	Lower Fox River Background Metals Assessment	20	20	
GLNPO Data - GB water congener data	1989/90 Green Bay Mass Balance Study (GLNPO)	1,681	1,681	
GLNPO Data - other water data	1989/90 Green Bay Mass Balance Study (GLNPO)	944	944	
GLNPO Data - sediment congener data	1989/90 Green Bay Mass Balance Study (GLNPO)	1,732		1,732
LLBdM RI/FS Deposit A - 1992, 1993 BBL	1992/93 BBL Deposit A Sediment Data Collection	112		112
LLBdM RI/FS Deposit A - 1992, 1993 BBL	1992/93 BBL Deposit A Water Data Collection	12	12	
LMMB Focus Group LHTP - Wisconsin State Lab of Hygiene	Lake Michigan Mass Balance Data3	4	4	
LMMB Focus Group LHTP - Wisconsin State Lab of Hygiene	Lake Michigan Mass Balance Data4	166	166	
LMMB Focus Group LHTP - Wisconsin State Lab of Hygiene	Lake Michigan Mass Balance Data5	35	35	
LMMB Focus Group LHTP - Wisconsin State Lab of Hygiene	Lake Michigan Tributary Monitoring Data	213	213	
LMMB Focus Group WWTH - University of Wisconsin Water Quality Laboratory	Lake Michigan Mass Balance Data2	52	52	
Lake Michigan Tributary Monitoring Study	Lake Michigan Tributary Monitoring Data	166	166	
USGS National Water Quality Assessment Program (NAWQA)	USGS NAWQA Data	10		10
WPDES Permit influent samples	WPDES Permit Influent Data	50	50	
Woody Clyde Deposit A Sediment Samples - 1994	1994 Woodward-Clyde Deposit A Sediment Collection	66		66
Total Number of Sediment and Water Records Ecological and Human Health I		11,182	4,480	6,702

Table 4-2 Number of Records Evaluated as Part of the Baseline Risk Assessment - All COPCs (Continued)

Source	Data Set	Total	Water	Sediment
Tissue Data for the Ecological Assessment				
1996 Fish tissue collection - WDNR	1996 WDNR Tissue Data Collection	35		
1998 BBL Sediment/Tissue Data collected for FRG	1998 BBL Sediment/Tissue Data Collection	20		
1998 FRG-Exponent's Database	1998 FRG/Exponent Database Data Collection	821		
1998 RI/FS Supplemental Data Collection	1998 RETEC RI/FS Supplemental Data Collection	623		
Cormorant data - 1994-1995	1994-1995 Cormorant Data Collection	1,430		
Fish Consumption Study Data	1998 WDNR Fish Consumption Data	5		
Fish Contaminant Study Data	Fox River Fish Consumption Advisory Data	385		
GLNPO Data - fish congener data	1989/90 Green Bay Mass Balance Study (GLNPO)	1,251		
GLNPO Data - other carp data	1989/90 Green Bay Mass Balance Study (GLNPO)	194		
GLNPO Data - other fish data	1989/90 Green Bay Mass Balance Study (GLNPO)	640		
KPatnode Tissue Data	WDNR Tissue Data Collection	5		
NRDA Tissue Data Collection	USFWS NRDA Tissue Data Collection	734		
State of Michigan Fish Consumption Advisory Data	Lake Michigan Fish Consumption Advisory Data	210		
Tree Swallow data - 1993-1996	1993-1996 Tree Swallow Data Collection	591		
Total Number of Tissue Records - Ecological Risk		6,944		
Tissue Data for the Human Health Assessment				
1996 Fish tissue collection - WDNR	1996 WDNR Tissue Data Collection	81		
1996 NRDA Waterfowl data	1997 USFWS Waterfowl Tissue Data Collection	88		
1998 BBL Sediment/Tissue Data collected for FRG	1998 BBL Sediment/Tissue Data Collection	54		
1998 FRG-Exponent's Database	1998 FRG/Exponent Database Data Collection	468		
Fish Consumption Study Data	1998 WDNR Fish Consumption Data	120		
Fish Contaminant Study Data	Fox River Fish Consumption Advisory Data	1,754		
KPatnode Tissue Data	WDNR Tissue Data Collection	69		
NRDA Tissue Data Collection	USFWS NRDA Tissue Data Collection	22		
State of Michigan Fish Consumption Advisory Data	Lake Michigan Fish Consumption Advisory Data	638		
Total Number of Tissue Records - Human Health Risk		3,294		
	Total Number of Records Evaluated for Risk:	21,420		

Table 4-3 Distribution of Existing Sediment, Water, and Tissue Data in the Lower Fox River and Green Bay over Time - Total PCBs Only

	Number of	f Samples A	Analyzed for To		QA Status		
Year	Sediment	Tissue (Caged)	Tissue (Resident)	Water	Validated	Supporting	Blank
1971			14			14	
1975			26			26	
1976			53			53	
1977			62			62	
1978			70			70	
1979			67			67	
1980			69			69	
1981			73			73	
1982			68			68	
1983			51			51	
1984			92			92	
1985			195			195	
1986			97			97	
1987	203		118			321	
1988	161		70			231	
1989	1,354		604	615		2,573	
1990	104		54	197		355	
1991			40			40	
1992	35		233	8	27	249	
1993	70		106	5	67	114	
1994	296		122	54	299	152	21
1995	484		87	40	484	109	18
1996	8		416		255	169	
1997	288		119		370	37	
1998	528	20	375	310	1,233		
1999	43	6	9	20	70	8	
TOTAL	3,574	26	3,290	1,249	2,805	5,295	39



#### Notes:

- 1. Resident caged tissue includes fathead minnows only.
- 2. Refer to the resident tissue worksheet tables for a breakdown of tissue types for the Lower Fox River and Green Bay.
- 3. The data query was for all samples collected over time for "total PCBs" analysis, and includes the sum of PCB congeners analyses.
- 4. The data query was limited to the four reaches of Lower Fox River and the four zones of Green Bay.
- 5. Samples without a year or location designation were eliminated from the data query.
- 6. The database does not have any air samples for total PCBs analysis.
- 7. Approximately 100 of the water samples collected in 1998 were from the Deposit N and SMU 56/57 demonstration project studies (during dredging).

Table 4-4 Distribution of Resident Tissue Samples over Time in the Lower Fox River - Total PCBs Only

		Fish														Birds			Mammals	Other			
Year		Benthi	c Fish		Game Fish					Pelag	ic Fish			Ti	rout		Raptors	Swallow	Upland Game Bird	Wate	rfowl	Fur Bearer	Insect/ Invertebrate
Tear	No. of Samples	No. of Species	No. of Fillet Samples	No. of Whole Fish Samples	No. of Samples	No. of Species		No. of Whole Fish Samples	No. of Samples	No. of Species	No. of Fillet Samples	No. of Whole Fish Samples	No. of Samples	No. of Species		No. of Whole Fish Samples	No. of Samples	No. of Samples	No. of Samples	No. of Samples	No. of Species	No. of Samples	No. of Samples
1971	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1976	6	2	7	0	11	4	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1977	24	3	18	6	12	3	10	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1978	24	3	10	9	14	3	5	8	0	0	0	0	4	1	3	0	0	0	0	0	0	0	0
1979	12	3	0	8	16	3	9	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1980	36	4	16	11	25	5	10	9	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0
1981	23	3	4	14	18	3	7	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	28	3	13	5	24	6	12	3	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0
1983	8	3	3	2	10	5	5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1984	8	2	5	2	14	7	7	0	0	0	0	0	0	0	0	0	0	0	1	3	1	1	1
1985	15	3	12	0	35	4	24	0	0	0	0	0	0	0	0	0	1	0	0	12	1	0	0
1986	16	4	9	2	18	3	12	2	1	1	0	1	0	0	0	0	0	0	0	28	1	0	0
1987	34	5	33	1	43	7	42	1	1	1	0	1	0	0	0	0	0	0	0	22	1	0	0
1988	7	2	7	0	6	2	6	0	0	0	0	0	0	0	0	0	0	0	0	6	1	0	0
1989	42	3	5	24	38	1	12	26	20	2	0	20	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
1991	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	20	2	12	8	111	9	103	9	4	1	0	4	0	0	0	0	0	0	0	0	0	0	0
1993	15	1	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	51	0	0	0	0	1
1994	10	2	0	5	13	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1996	109	6	20	84	185	7	131	34	13	3	0	13	0	0	0	0	0	0	0	0	0	0	0
1997	3	1	0	3	17	1	0	0	0	0	0	0	0	0	0	0	0	0	0	22	2	0	0
1998	93	4	75	48	198	7	163	59	17	3	0	17	0	0	0	0	0	0	0	0	0	0	10
1999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

#### Notes:

<sup>1.</sup> No piscivorous birds were collected in the Lower Fox River.

<sup>2.</sup> No cormorants were collected in the Lower Fox River.

Table 4-5 Distribution of Resident Tissue Samples over Time in Green Bay - Total PCBs Only

	Fish												Birds										nmals					
		Benth	ic Fish	Game Fish			Pelag	ic Fish			Tr	out		Corr	norant		vorous rds	Raptors	s Swallow		w Waterfowl		Deer	Fur Bearer	Other			
Year		No. of Species	No. of Fillet Samples	No. of Whole Fish Samples	No. of Samples	Coories		No. of Whole Fish Samples	No. of Samples	No. of Species	No. of Fillet Samples	No. of Whole Fish Samples	No. of Samples	No. of Species		No. of Whole Fish Samples	No. of Samples		No. of Samples		No. of Samples		No. of Species	No. of Samples	No. of Species	No. of Samples	No. of Samples	No. of Samples
1971	0	0	0	0	0	0	0	0	0	0	0	0	14	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1975	7	1	0	0	18	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1976	15	3	20	0	20	8	28	0	1	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1977	5	2	11	0	21	3	36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1978	7	2	6	1	9	2	7	2	7	3	4	1	5	I	5	1	0	0	0	0	0	0	0	0	0	0	0	0
1979	8	4	0	8	17	4	8	9	9	3	0	9	5	3	0	5	0	0	0	0	0	0	0	0	0	0	0	0
1980	3	1	3	0	4	3	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1981	15	1	0	15	13	2	12	0	0	0	0	0	4	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0
1982	5	1	5	0	4	1	4	0	0	0	0	0	5	1	5	0	0	0	0	0	0	0	0	0	0	0	0	0
1983	12	3	10	2	13	4	13	0	9	1	2	2	4	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0
1984 1985	8	0	8	0	23	6 2	23 2	0	4	3	0	4	20 125	4 5	20	0	0	0	0	0	0	0	0	4	2	0	0	0
1986	5	1	5	0	9	3	9	0	2	1	0	2	123	2	120	0	0	0	1	1	0	0	0	13	1	0	0	,
1987	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	16	3	1	0	0
1988	20	2	20	0	11	2	11	0	10	1	11	0	0	0	0	0	0	0	0	0	0	0	0	10	2	0	0	0
1989	166	1	28	77	101	2	35	66	169	3	0	169	68	3	29	39	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	22	3	22	0	9	2	0	9	22	2	22	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	5	1	5	0	16	2	10	0	18	3	12	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	10	1	0	10	35	3	25	10	7	2	0	7	46	5	43	3	0	0	0	0	0	0	0	0	0	0	0	0
1993	6	2	2	4	0	0	0	0	2	1	0	2	16	2	16	0	0	0	0	0	0	15	1	0	0	0	0	0
1994	0	0	0	0	19	2	19	0	4	1	0	4	16	3	16	0	60	1	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	1	1	0	0	4	1	0	4	0	0	0	0	80	1	0	0	0	0	0	0	0	0	0	1
1996	0	0	0	0	60	3	20	24	0	0	0	0	29	4	10	19	0	0	15	2	0	0	0	5	1	0	0	0
1997	0	0	0	0	71	2	0	15	0	0	0	0	1	I	0	0	0	0	5	1	0	0	0	0	0	0	0	0
1998	12	2	0	12	32	4	10	22	8	2	0	8	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	3
1999	0	0	0	0	8	1	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	I	0

<sup>1.</sup> No reptiles were collected in Green Bay.

No upland game birds were collected in Green Bay.
 Date query included all sample body types. The number of whole samples included whole fish and whole fish composites for fish, and whole body for birds.